

# Understanding and Configuring ATM PVC Bundles

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## Introduction

When you use Per-VC (distributed) Weighted Random Early Discard (Per-VC (D)WRED), you can perform an intelligent packet discard when congestion occurs. However, this solution limits you to the use of one Permanent Virtual Circuit (PVC) between two end devices. As a result, the different service classes (streams with different IP precedence values) experience different drop probabilities. The non-discarded packets experience the same Quality of Service (QoS) or delay characteristics. This means that the ATM PVC traffic class must be selected to satisfy the most demanding QoS. This can cause problems if you have different types of traffic, such as voice and data.

This limitation is solved by PVC bundles, which allow you to assign different QoS parameters to various types of traffic while you are still able to use Per-VC DWRED.

**Note:** Distributed mechanisms (such as distributed Cisco Express Forwarding (DCEF) or DWRED) are specific to a 7500/Virtual Interface Processor (VIP) architecture. These mechanisms are not handled by the Route Switch Processor (RSP) CPU, but by the CPU on the VIP module.

## Prerequisites

### Requirements

There are no specific requirements for this document.

## Components Used

The information in this document is based on these software and hardware versions:

- Cisco IOS® Software Release 12.0(3)T and later
- Cisco 7500: VIP2–50, all PA–A3 versions. (only one PA–A3 per VIP2–50)
- Cisco 7200: NPE200 or later, all PA–A3 versions
- Cisco 2600 and 3600:
  - ◆ Cisco IOS® Software Release 12.0(7)T and later with the NM–1A–OC3 and the NM–4E1–IMA, NM–4T1–IMA, NM–8E1–IMA, NM–8T1–IMA network modules
  - ◆ Cisco IOS® Software Release 12.1(2)T and later with the NM–1A–T3 and NM–1A–E3 network modules

**Note:** With the Cisco 2600 platform, the NM–1A–OC3 is only supported on the Cisco 2691 and requires at least Cisco IOS® Software Release 12.2(13)T and an IP Plus of service provider (–p) feature set.

**Note:** Both ends of the connection (routers) must support PVC bundles.

The information presented in this document was created from devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command before you use it.

## Conventions

For more information on document conventions, refer to the Cisco Technical Tips Conventions.

## Understand PVC Bundles

ATM PVC bundle management allows you to configure multiple PVCs that have different QoS characteristics between two end devices.

You bind a PVC from the bundle to one, or several, precedence values. To determine which VC in the bundle is to be used to forward specific traffic, the ATM VC bundle management software matches precedence levels between packet and VCs.

Additionally, you can run Per–VC DWRED to perform intelligent discards per–vc and per precedence value on each VC.

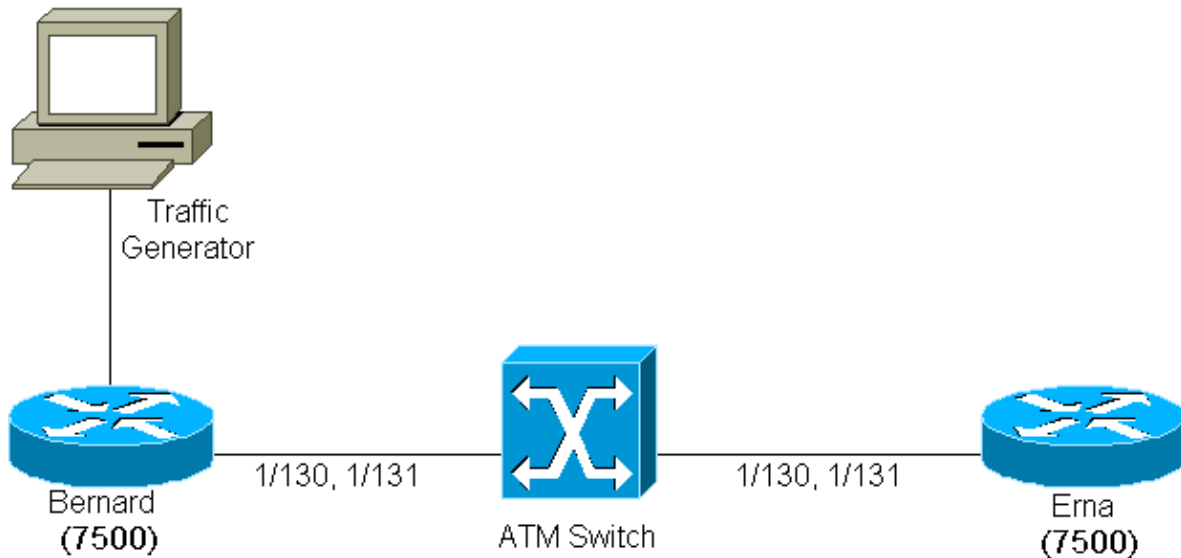
## Configure

In this section, you are presented with the information to configure the features described in this document.

**Note:** To find additional information on the commands used in this document, use the Command Lookup Tool (registered customers only) .

## Network Diagram

This document uses the network setup shown in this diagram:



Two PVCs are created between Erna and Bernard (two 7507s that use a PA-A3 in a VIP2-50 and run Cisco IOS® version 12.0(7)T).

These two PVCs have been assigned the values 1/130 and 1/131 on both ends of the connection. For the sake of clarity, 1/130 is switched to 1/130 by the ATM switch and 1/131 is switched to 1/131.

The PVC 1/130 is configured as a variable bit rate-nonreal time (VBR-nrt) VC and 1/131 is configured as an available bit-rate (ABR) VC. The precedence values 0 to 4 are bound to PVC 1/130, and precedence values 5 to 7 are bound to the PVC 1/131. Per-VC DWRED is used as the packet discard mechanism.

## Configurations

This document uses the configurations shown here:

- Bernard
- Erna

Bernard
<pre> random-detect-group testWRED   exponential-weighting-constant 2   precedence 3 100 1000 3   precedence 5 200 1000 5 ! ip cef distributed ! interface ATM2/0/0   ip route-cache distributed   ip route-cache cef ! interface ATM2/0/0.6 point-to-point   ip address 14.0.0.1 255.0.0.0   no ip directed-broadcast <b>bundle bernard</b>   protocol ip 14.0.0.2 broadcast   broadcast   oam-bundle manage <b>pvc-bundle 1/131</b>   class-vc ABR   random-detect attach testWRED <b>precedence 5-7</b> </pre>

```

pvc-bundle 1/130
  random-detect attach testWRED
  vbr-nrt 100 10
  precedence 0-4
!
vc-class atm ABR
abr 1000 100

```

### Ema

```

random-detect-group testWRED
  exponential-weighting-constant 2
  precedence 3 300 1000 3
  precedence 5 2000 4000 5
!
ip cef distributed
!
interface ATM2/0/0
  ip route-cache distributed
  ip route-cache cef
!
interface ATM2/0/0.6 point-to-point
  ip address 14.0.0.2 255.0.0.0
  no ip directed-broadcast
  bundle ema
    protocol ip 14.0.0.1 broadcast
    broadcast
    oam-bundle manage
    pvc-bundle 1/131
      class-vc ABR
      random-detect attach testWRED
      precedence 5-7
    pvc-bundle 1/130
      random-detect attach testWRED
      vbr-nrt 100 50
      precedence 0-4
!
vc-class atm ABR
abr 1000 100

```

**Note:** When you create the PVCs for a PVC bundle, do not use virtual channel identifier (VCI) equal to 3 or 4 as these values are reserved for F4 (virtual path connection [VPC] level) Operation, Administration, and Maintenance (OAM) segment and end-to-end loopback management. If you do this, you receive this error message:

**Note:** %ATM: Invalid VCI of 4 requested: (ATM6/ima1): Not creating vc:63:4 as in the output here:

```

7200-16(config)#int atm 6/ima1.12 point-to-point
7200-16(config-subif)#bundle Test
7200-16(config-if-atm-bundle)#pvc-bundle Red 63/4
%ATM: Invalid VCI of 4 requested: (ATM6/ima1): Not creating vc:63:4

```

## Selected Outputs

In order to show the results of the PVC bundle, a traffic generator sends two streams of data: one with the IP precedence equal to 3 and one with the IP precedence equal to 5.

In the configuration shown the stream IP precedence three must go across the pvc 1/130, and the traffic with IP precedence 5 across the PVC 1/131. This can be verified in this **show** command output:

```
bernard#show queuing interface atm 2/0/0.6
```

```
Interface ATM2/0/0.6 VC 1/131
```

```
Exp-weight-constant: 2 (1/4)
```

```
Mean queue depth: 0
```

```
Queue size: 0 Maximum available buffers: 2628
```

```
Output packets: 802 WRED drops: 14 No buffer: 121515
```

Class	Random drop	Tail drop	Minimum threshold	Maximum threshold	Mark probability	Output Packets
0	0	0	20	40	1/10	0
1	0	0	22	40	1/10	0
2	0	0	24	40	1/10	0
3	0	0	100	1000	1/3	0
4	0	0	28	40	1/10	0
<b>5</b>	<b>13</b>	<b>0</b>	<b>200</b>	<b>1000</b>	<b>1/5</b>	<b>772</b>
6	0	0	32	40	1/10	0
7	0	0	34	40	1/10	0

```
Interface ATM2/0/0.6 VC 1/130
```

```
Exp-weight-constant: 2 (1/4)
```

```
Mean queue depth: 781
```

```
Queue size: 781 Maximum available buffers: 2628
```

```
Output packets: 53 WRED drops: 114 No buffer: 121413
```

Class	Random drop	Tail drop	Minimum threshold	Maximum threshold	Mark probability	Output Packets
0	0	0	20	40	1/10	17
1	0	0	22	40	1/10	0
2	0	0	24	40	1/10	0
<b>3</b>	<b>114</b>	<b>0</b>	<b>100</b>	<b>1000</b>	<b>1/3</b>	<b>817</b>
4	0	0	28	40	1/10	0
5	0	0	200	1000	1/5	0
6	0	0	32	40	1/10	0
7	0	0	34	40	1/10	0

You can see that traffic flows across the proper VC based on the traffic's PVC IP precedence.

```
bernard#show atm bundle
```

```
bernard on ATM2/0/0.6: UP
```

VC Name	VPI/ VCI	Config Preced.	Current Preced.	Bumping Preced./ Accept	PG/ PV	Peak Kbps	Avg/Min kbps	Burst Cells	Sts
3	1/131	7-5	7-5	4 / Yes	-	1000	100		UP
6	1/130	4-0	4-0	- / Yes	-	64	10	94	UP

Also note that when the VIP2-50/PA-A3 DWRED is turned on, there are no drops on the PA-A3. However, there are drops on the VIP. You can verify this in the output shown here:

```
bernard#show atm pvc 1/130
```

```
ATM2/0/0.6: VCD: 6, VPI: 1, VCI: 130
```

```
VBR-NRT, PeakRate: 64, Average Rate: 10, Burst Cells: 94
```

```
AAL5-LLC/SNAP, etype:0x0, Flags: 0x100020, VCmode: 0x0
```

```
OAM frequency: 10 second(s), OAM retry frequency: 1 second(s), OAM retry frequency: 1 second(s)
```

```
OAM up retry count: 3, OAM down retry count: 5
```

```
OAM Loopback status: OAM Received
```

```
OAM VC state: Verified
```

```
ILMI VC state: Not Managed
```

```
VC is managed by OAM.
```

```
InARP frequency: 15 minutes(s)
```

```
Transmit priority 2
```

```
InPkts: 55, OutPkts: 86, InBytes: 3700, OutBytes: 105654
```

```
InPRoc: 49, OutPRoc: 17
```

```

InFast: 0, OutFast: 0, InAS: 7, OutAS: 69
InPktDrops: 42, OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0
OAM cells received: 169
F5 InEndloop: 169, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 0
F4 InEndloop: 0, F4 InSegloop: 0, F4 InAIS: 0, F4 InRDI: 0
OAM cells sent: 169
F5 OutEndloop: 169, F5 OutSegloop: 0, F5 OutRDI: 0
F4 OutEndloop: 0, F4 OutSegloop: 0, F4 OutRDI: 0
OAM cell drops: 0
Status: UP

```

```
bernard#show atm pvc 1/131
```

```

ATM2/0/0.6: VCD: 3, VPI: 1, VCI: 131
ABR, PeakRate: 1000, Minimum Rate: 100, Initial Rate: 1000, Current Rate: 998
RIF: 16, RDF: 16
FRM cells received: 165, BRM cells received: 910
RM cells sent: 1073
AAL5-LLC/SNAP, etype:0x0, Flags: 0x110820, VCmode: 0x0
OAM frequency: 10 second(s), OAM retry frequency: 1 second(s), OAM retry frequency: 1 second(s)
OAM up retry count: 3, OAM down retry count: 5
OAM Loopback status: OAM Received
OAM VC state: Verified
ILMI VC state: Not Managed
VC is managed by OAM.
InARP frequency: 15 minutes(s)
Transmit priority 3
InPkts: 31, OutPkts: 854, InBytes: 3640, OutBytes: 1227090
InPRoc: 31, OutPRoc: 34InFast: 0, OutFast: 0, InAS: 0, OutAS: 820
InPktDrops: 0, OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0
OAM cells received: 180
F5 InEndloop: 180, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 0
F4 InEndloop: 0, F4 InSegloop: 0, F4 InAIS: 0, F4 InRDI: 0
OAM cells sent: 184
F5 OutEndloop: 184, F5 OutSegloop: 0, F5 OutRDI: 0
F4 OutEndloop: 0, F4 OutSegloop: 0, F4 OutRDI: 0
OAM cell drops: 0
Status: UP

```

## Alternative Configuration Method

The other configurations included in this document are based on Cisco 7500 routers. As you can see, the PVC bundle options are configured on the bundle and the PVCs themselves. This type of configuration is also achieved through the use of vc-classes. Here is an example:

Configuration
<pre> <b>vc-class atm atm-bundle</b>   broadcast   oam-pvc manage 1   oam retry 3 3 1   encapsulation aal5snap   protocol ip inarp broadcast   oam-bundle manage 1 ! <b>vc-class atm data</b>   vbr-nrt 4096 2048 32   precedence 0-4   no bump traffic   protect vc ! <b>vc-class atm vo-ip</b>   vbr-nrt 4096 2048 32 </pre>

```

precedence 5-7
no bump traffic
protect vc
!
interface ATM1/0.100 point-to-point
mtu 1500
bandwidth 2000
ip address 1.1.1.1 255.0.0.0
bundle test
  class-bundle atm-bundle
  max-vcnun 0
  pvc-bundle vo-ip 2/202
  class-vc vo-ip
  pvc-bundle data 1/101
  class-vc data

```

The vc-class **atm-bundle** allows you to define the bundle parameters, while the classes **vo-ip** and **data** define the parameters of each of the VCs.

## Incomplete Configuration Or PV Down Message

If the PVC bundle configuration is not complete, the bundle goes down, and provides this reason:

```
Incomplete config, PV down
```

This error is usually caused by a precedence which is not mapped to a PVC. Even if a precedence is not used, the precedence must be mapped to a PVC in the bundle. This is an example:

Configuration
<pre> vc-class atm atm-bundle   broadcast   oam-pvc manage 1   oam retry 3 3 1   encapsulation aal5snap   protocol ip inarp broadcast   oam-bundle manage 1 ! vc-class atm dus-mun-data   vbr-nrt 4096 2048 32   precedence 0-4   no bump traffic   protect vc ! vc-class atm vo-ip   vbr-nrt 4096 2048 32   precedence 5-6   no bump traffic   protect vc </pre>

Issue the **show atm bundle** command:

```
Damme#show atm bundle
test on ATM1/0.100: DOWN, Incomplete config, PV down
```

VC Name	VPI/ VCI	Config Preced.	Current Preced.	Bumping Preced./ Accept	PG/ PV	Peak Kbps	Avg/Min kbps	Burst Cells	Sts
dus-mun-data	1/101	4-0		- / No	PV	4096	2048	32	UP
vo-ip	2/202	6-5		- / No	PV	4096	2048	32	UP

As you can see, **precedence 7** was not mapped to a PVC, which causes the whole bundle to go down. If you add **precedence 7** under the `vo-ip pvc`, the bundle comes UP.

```
Damme#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Damme(config)#vc-class atm vo-ip
Damme(config-vc-class)#pre
Damme(config-vc-class)#precedence 7
Damme(config-vc-class)^Z
Damme#
Damme#show atm bundle

test on ATM1/0.100: UP

VC Name          VPI/ VCI    Config   Current   Bumping  PG/ Peak Avg/Min Burst
                 Preced.    Preced.  Preced./ PV  Kbps  kbps  Cells Sts
                 Accept

vo-ip            2/202      7-5      7-5       - / No   PV   4096  2048  32   UP
dus-mun-data    1/101      4-0      4-0       - / No   PV   4096  2048  32   UP
```

## Known Caveats

### Cisco Bug ID CSCdm43184

Bug CSCdm43184: CAR + PVC bundling = packets forwarded on wrong VC

Release Notes: If you use committed access rate (CAR) to set the precedence bits in the IP header, it is possible for the packets to be sent to the wrong PVC in a PVC bundle. This is observed in Cisco IOS® Software Release 12.0(4)T. In this situation, packets are switched if the packets come in with the precedence bits set out on the correct VCs in the bundle. The incoming packets without the precedence bits set (set by CAR) are switched out on the precedence 0 VC. This seems to imply that the precedence levels are changed by CAR after the decision to switch to CEF is made.

### Cisco Bug ID CSCds80669

Bug CSCds80669: VBR-nrt not a configuration option with `pvc-bundle` command mode

Release Notes: VBR-nrt is not available under the PVC bundle configuration:

```
cop-ves9-wan-gw1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
cop-ves9-wan-gw1(config)#interface ATM2/0.100 point-to-point
cop-ves9-wan-gw1(config-subif)# bundle cop-sto
cop-ves9-wan-gw1(config-if-a)# pvc-bundle cop-sto-data 103/1
cop-ves9-wan-gw1(config-if-a)#?
ATM VC bundle member configuration commands:
abr          Enter Available Bit Rate (pcr)(mcr)
class-vc    Configure default vc-class name
default      Set a command to its defaults
exit        Exit from ATM bundle member configuration mode
no          Negate a command or set its defaults
ubr+       Enter Peak Cell Rate(pcr)Minimum Cell Rate(mcr) in Kbps.
```

For this example, Cisco IOS® Software Release 12.1(3a)T4 runs on a Cisco 3640 platform.



# Verify

This section provides information you can use to confirm that your configuration functions properly.

Certain **show** commands are supported by the Output Interpreter Tool (registered customers only) , which allows you to view an analysis of **show** command output.

- **show atm bundle bundle-name [stat] [detail]** Displays detailed statistics on a specified bundle
- **show atm map** Displays the list of all configured ATM static maps to remote hosts on an ATM network and on ATM bundle maps
- **show queuing interface atm [x/[y/[z]]].w** Displays the queueing statistics of an interface
- **show random-detect-group** Displays the WRED or DWRED parameter group

This is the command output for the **show atm bundle bundle-name [stat] [detail]** command:

```
Bundle Name: Bundle State: UP
AAL5-NLPID
OAM frequency: 0 second(s), OAM retry frequency: 1 second(s)
OAM up retry count: 3, OAM down retry count: 5
BUNDLE is managed by.
InARP frequency: 15 minutes(s)
InPkts: 3695, OutPkts: 4862, InBytes: 407836, OutBytes: 2848414
InPRoc: 3579, OutPRoc: 3211, Broadcasts: 0
InFast: 0, OutFast: 0, InAS: 116, OutAS: 1652
InPktDrops: 42, OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0
```

This is the command output for the **show atm map** command:

```
bernard#show atm map
Map list bernard_B_ATM2/0/0.6 : PERMANENT
ip 14.0.0.2 maps to bundle bernard, 1/131, 1/130, ATM2/0/0.6
, broadcast, aal5mux
```

# Troubleshoot

This section provides information you can use to troubleshoot your configuration.

## Troubleshooting Commands

Certain **show** commands are supported by the Output Interpreter Tool (registered customers only) , which allows you to view an analysis of **show** command output.

**Note:** Before you issue **debug** commands, refer to Important Information on Debug Commands.

- **debug atm bundle errors** Enables the display of information on bundle errors
- **debug atm bundle events** Enables the display of bundle events when use occurs

## Related Information

- [ATM Technology Support Pages](#)
- [Technical Support & Documentation – Cisco Systems](#)

